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Circular Path Removing Dynamic Routing Algorithm(CPRDRA) of a Smart City Project

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Abstract

The Smart City project is very efficient communication technologies for network researchers. These technologies are typically based on dynamic routing algorithm. In this paper I propose a new routing protocol for wireless ad-hoc network based Smart City. It is important to note that information transmitted by every vehicle is anonymous and does not include any personally identifying information such as name, license or any unique identification number. The primary objective is to prepare a new routing protocol for wireless ad-hoc network based Smart City. We develop a micro traffic simulator that provides road networks created from real maps, routing algorithms, and vehicles that travel from origins to destinations depending on traffic conditions. The proposed protocol is demand based reactive protocol that search a route between source node(S) and destination node (D) when required. The shortest path is stored in the route table along with a time stamp value (T). Distance is calculated from S to D using motion vector. This protocol eliminates the problems of Path Prediction and Path History. This paper is also analyzing by using the density of the route.

1. INTRODUCTION

“The traffic conditions in urban areas are not satisfactory due to wasted time, fuel, and travel unreliability, for example, arrive at destinations is time consuming.

Factors affecting level of service:
The level of service can be derived from a road under different operating characteristics and traffic volumes.
The factors affecting level of service (LOS) can be listed as follows:

1. Speed and travel time
2. Traffic interruptions/restrictions
3. Freedom to travel with desired speed
4. Driver comfort and convenience
5. Operating cost.

Intelligent Transportation Systems (ITS) is one solve this problem by exploiting the advances in information technology, for example, dynamically controlling traffic lights based on traffic conditions and routing vehicles using current and historical traffic information.

Intelligent Transportation System is application of computer, electronics, and communication technologies in an integrated manner to provide high safety and efficiency of the transportation system.

ITS services:

1. Uninterrupted internet services
2. Traffic management
3. E-toll
4. Vehicle control and safety
5. Recovery from accident
6. Maintenance

The Internet of vehicles (IoV) is connecting vehicles over internet, letting them talk and making applications. IoV includes different types of communications including vehicle to vehicle v2v, vehicle to RSU v2r, vehicle to toll sensor v2ts and vehicle to internet v2i. IoV is better than GPS, and it solves the GPS unavailability. The technology development and large-scale employment of the IoV introduce new services and also make the existing services more reliable and more efficient. in IoV each vehicle is considered as an object contained a powerful sensor, IT, Arithmetic and logical unit and IP address. All the vehicles either directly or indirectly connected to each others.

To prepare a new routing protocol for wireless ad-hoc network based Smart City I use the following steps:

1. Create a road map of the city
2. Routing Algorithm
3. Routing controller
4. Performance

In this work, I show that Circular Path Removing Routing Algorithm of Smart City Project is important to improve road efficiency. To create a road map where a vehicle moves from the source to the destination passing through multipath, I consider the map as a graph. We use QGIS translator for this purpose. After translation, our preprocessor converts the simplified XML file into a target adjacency list and matrix. I develop a routing algorithm called Circular Path Removing Routing Algorithm reroutes all vehicles based on current traffic conditions. The first objective of the central routing system is to make a dummy shortest path by removing the circular path. The second objective is to collects all the routing requests from the vehicles arriving at any nodes and traverses them to the network. If the request reaches to the destination node then the reply along the reverse path will back. The algorithm searches whether the RREQ contains the cycle or not. If there is cycle then update the RREQ with cycle data and use the dummy path. If the TTL reaches a threshold value then there is not any destination node.

To estimation Travel Time I use the mean velocity of a vehicle on the link calculated from Greenshield's macroscopic stream model. Macroscopic stream models represent how the behavior of one parameter of traffic flow changes with respect to another. Most important among them is the relation between speed and density.

I develop a micro level traffic simulator and also use some commercial simulators to evaluate the performance of the Dynamic routing. The simulators consist of a map creator, a traffic generator, a routing controller, a vehicle simulator, and a performance evaluator. We use QGIS to create a realistic map and parse the map to extract the information that we need for simulation.

In the performance part I also discuss about Packet Delivery Ratio (PDR), Average End-to-End Delay, Packet Dropped and Network Throughput with an output.

1. <u>Create a road map of the city</u>

To create a road map where a vehicle moves from the source to the destination passing through multipath, I consider the map as a graph. We use QGIS translator for this purpose. After translation, our preprocessor converts the simplified XML file into a target adjacency list and matrix.

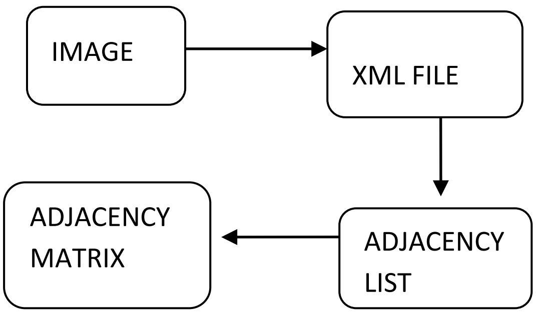


Figure: Process of Road map creation

R(t) be set of vehicles on the road at time t and E(R(t)) is the number of elements in R(t). The time slice value that represents the digital clock time is parameterized to be changed according to the time scale in a simulation, for example, 1 slice as 0.1 second in my experiments. S (V (n)) is the source of the vehicle number n and D (V (n)) is the destination of the vehicle number n.

t=0, R(t)=NULL and FLAG=0

N be the Number of vehicles generated at each slice

While (FLAG==0){

While(t!=0.1){

If VEHICLE then add vehicle details to R(t) else discard

}

For i=1 to N(R(t)){

Update the list

For each n

If (S(V(n))==D(V(n))) then

Remove from R(t)

Else

Get a new link

End if

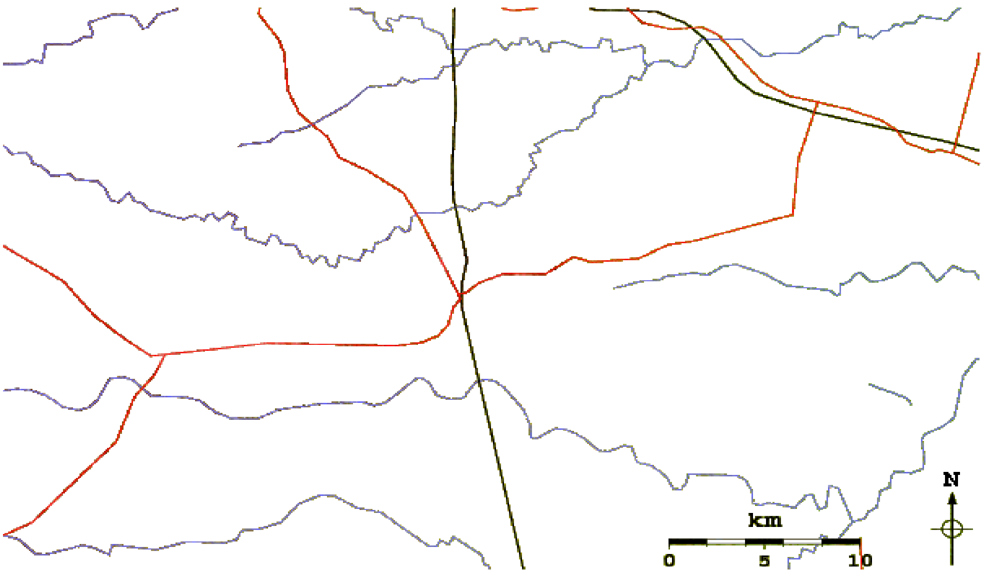
End for

}

If R(t)==NULL then FLAG=1

t=t+.1

}



Route Map of proposed Smart City Bolpur Santiniketan, India.

2. TRAVEL TIME ESTIMATION

Two types of delay arise as a vehicle travels: 1) delay to travel from entry point to exit point 2) delay waiting at an intersection. In this research, I focus only on delay on road segments (the former, also known as link delay) for route guidance, and the latter will be dealt with in the future work. Specifically, we estimate delay d_{ij} on link e_{ij} as follows:

$$d_{ij}=l_{ij}/v$$

where l_{ij} is the length of e_{ij}, that is, the distance from n_i to n_j , and v is the mean velocity of a vehicle on the link calculated from Greenshield's macroscopic stream model.

Greenshield's macroscopic stream model:

Macroscopic stream models represent how the behavior of one parameter of traffic flow changes with respect to another. Most important among them is the relation between speed and density.

$$v = v_f – [v_f/k_j].k$$

where v is the mean speed at density k, v_f is the free speed and k_j is the jam density. This equation is often referred to as the Greenshields' model. It indicates that when density becomes zero, speed approaches free flow speed (ie. $v \to v_f$ when $k \to 0$).

3. ROUTE DISCOVERY

In this Algorithm I maintained every modes in multi linked list system.

Cycle Step : The first objective is to find that if there is some cycle in between the nodes. If found then calculate the shortest path between Start node of the cycle and the End node of the cycle and mark them as cycle (<Start node>, <next node>, < End node>, value).

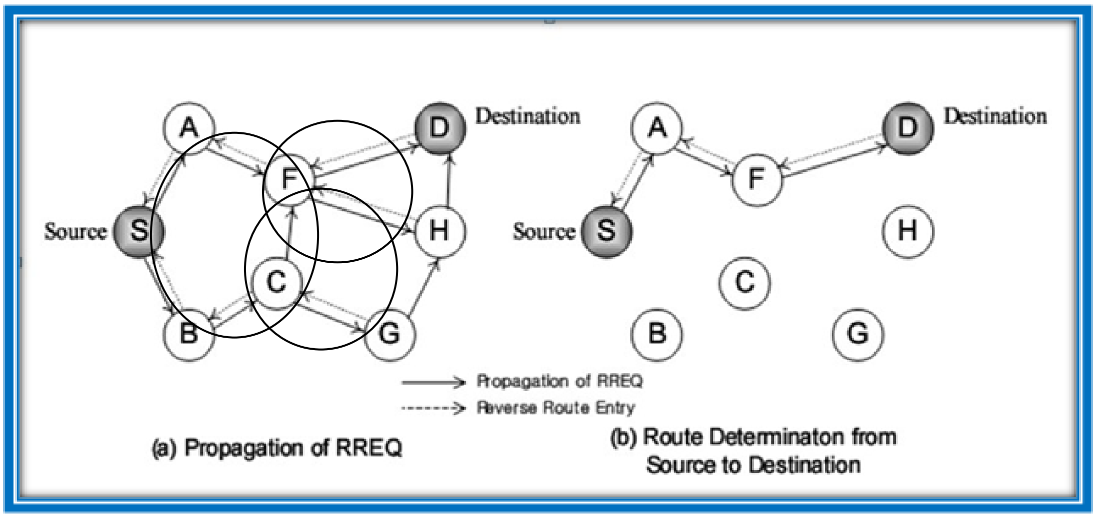
Request Step: When a source node (S) has to send data packets to a destination node (D) then the source node initiates a route discovery process by sending RREQ (Route Request) packet to all its neighbors. The RREQ packet contains the source node ID , destination node ID, monotonically increasing value Time to Live (TTL) a time stamp value V, next hop field. When a RREQ reaches a node and if it is not the D, it add its ID to the next hop field and move next to its neighbors. This continues until the RREQ packets reaches the destination node or the TTL reaches a threshold value.

SID	DID	TTL	V	Next hop

Reply Step : 1) Route Found: To reply RREP along the reverse path the algorithm searches whether the REQ contains the cycle or not. If there is cycle then update the RREQ with cycle data.

2) Not Found: If the TTL reaches the threshold value, then the next immediate node on the network discards (RREQ) packet and sends Route Error (ERR) packet to the source node along reverse path.

So, if the RREQ packet reaches the destination node, it sends a RREP packet along the reverse path. REP packet contains SID, DID, TTL, V.



4. PERFORMANCE:

1. Packet Delivery Ratio (PDR)

   This is the ratio of total data received to total data sent from source to destination. It measures the loss rate in the network. (PDR= data delivered to the destination /data sent out by the source)

2. Average End-to-End Delay

   This is the average time that a packet takes to traverse from the source node to the destination node in a network.

3. Packet Dropped

   This represents the total number of packets discarded by all nodes in the network.

4. Network Throughput

   Throughput is the average rate of successful message delivery over a communication channel.

PDR	Average End-to-End Delay	Average Throughput	Total Packet Dropped
Very Low	High	High	Very Low

CONCLUSION AND FUTURE WORK:

I have demonstrated that traffic routing system of a Smart City to improve road efficiency. I propose a traffic routing algorithm that utilizes both current and near-future traffic conditions using already routed vehicles. The performance of this routing algorithm is evaluated via simulations of the road network. This study has some limitations including traffic light control, car-following dynamics, lane change rules, and routing algorithms that take into account intersection delays. Such simulations will certainly help assess the proposed algorithm more accurately.

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